Clinical Example

Clinical Background
• Chlamydia trachomatis infection is one of the most prevalent sexually transmitted diseases (STDs) in many parts of the world, including both developing and developed countries
• C. trachomatis infection has also been found to be the most prevalent STD in a national survey conducted in China
• It is estimated that 50% to 90% of chlamydial infections in women are asymptomatic.
Clinical Background (II)

• If untreated, chlamydial infections can lead to many complications and sequelae in infected women, including pelvic inflammatory disease (PID), ectopic pregnancy, tubal infertility, and chronic pelvic pain

• *C. trachomatis* infection can also be transmitted by women to male sexual partners, leading to urethritis and epididymitis

Clinical Background (III)

• Therefore, screening and treatment for women found infected have been recommended and implemented in many STD control programs

• A number of studies have assessed the cost-effectiveness or cost-benefit of screening for *C. trachomatis* in populations with diverse rates of chlamydial infection rates supporting more informed decision-making. However, economic analysis to assess the cost-effectiveness of prophylactic treatment for chlamydial infections in women seeking induced abortions has rarely been conducted

Clinical Background (IV)

• The authors therefore conducted a cost-effectiveness analysis, aiming to make recommendations for the health authority and health providers through evaluating the incremental cost-effectiveness of [universal screening strategy (with PCR assay) and] prophylaxis with azithromycin versus no intervention for women seeking induced abortions

  – For simplicity – and because the authors concluded that universal screening is dominated by prophylaxis – only their evaluation of prophylaxis vs do nothing is reviewed here
Steps in Decision Analysis
1. Imagine the model, and draw the tree
2. Identify the probabilities
3. Identify the outcome values
4. Calculate expected values
5. Perform sensitivity analyses

Types of Nodes
- Decision nodes (squares)
- Chance nodes (circles)
- Terminal nodes (branch endings)
Initial Choice

No Prophylaxis

Prophylaxis

No Prophylaxis, Chlamydia Yes/No

No Prophylaxis, Chlamydia

Yes

No

Chlamydia

No Chlamydia

Prophylaxis

Rule 1

Node branches must be exhaustive and mutually exclusive.
Rule 2

At each chance node, the sum of the branch probabilities must equal 1.0

PID Yes/No

Symptomatic Yes/No
Prophylaxis, Chlamydia Yes/No

PID Yes/No

Symptomatic Yes/No
Steps in Decision Analysis

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Outcome Probabilities

- Chlamydia: 0.048 (97 / 2020)  
- PID: 0.63 (Literature)  
- Symptomatic PID: 0.40 (Literature)  
- Chlamydia | Azithromycin*: 0.04 (Literature)

*1/24 not cured; No comparison group (Rustomjee)

Identify the Probabilities
Steps in Decision Analysis

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Possible Outcome Measures

- Number of cases of PID avoided
- Percentage survival at 10 years
- Life expectancy
- Cost of choices (money value)
- Utility (e.g., QALYs)

Possible Outcome Measures

- **Number of cases of PID avoided** (clinical outcome)
- Percentage survival at 10 years
- Life expectancy
- **Cost of choices (money value)** (cost outcome)
- Utility (e.g., QALYs)
Cost Estimates

- Chlamydia and symptomatic PID * 1455 RMB
- Chlamydia and asymptomatic PID * 630
- Chlamydia alone * 42
- No chlamydia / no PID 0
- Azithromycin prophylaxis 40

* See next slides for detail

Chlamydia with Symptomatic PID

- PID inpatient care: 0.14 * 1617
- PID outpatient care: 0.86 * 696
- PID sequelae for women
  - Chronic pelvic pain: 0.18 * 1400 / 1.03²
  - Ectopic pregnancy: 0.08 * 4408 / 1.03⁵
  - Infertility: 0.12 * 0.25 * 2054 / 1.03¹⁰
- Chlamydia transmission to men (p = 0.68)
  - Urethritis 0.40 * 140
  - Epididymitis 0.02 * 300
  = 1455

Chlamydia with Asymptomatic PID

- PID sequelae for women
  - Chronic pelvic pain: 0.18 * 1400 / 1.03²
  - Ectopic pregnancy: 0.08 * 4408 / 1.03⁵
  - Infertility: 0.12 * 0.25 * 2054 / 1.03¹⁰
- Chlamydia transmission to men (p = 0.68)
  - Urethritis 0.40 * 140
  - Epididymitis 0.02 * 300
  = 630
Chlamydia, No PID

- Chlamydia transmission to men (p = 0.68)
  - Urethritis 0.40 * 140
  - Epididymitis 0.02 * 300
  = 42

Identify the Outcomes

Symptomatic

Chlamydia 0.48
PID 0.82
No Chlamydia 0.37

Asymptomatic

Chlamydia 0.52
PID 0.18
No Chlamydia 0.37

PID

0.63
No PID

0.37

Prophylaxis

0.48
No Prophylaxis

0.52

Steps in Decision Analysis

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Two Methods of Calculation

- Average out and fold back
- Path probabilities

Average Out Formula

\[
\text{Expected Value} = \sum \text{Probability}_i \times \text{Outcome}_i
\]

Symptomatic / Asymptomatic Average Out Example

- Symptomatic: $1,455; P = 0.40$
- Asymptomatic: $630; P = 0.60$

\[\begin{array}{c}
\text{Symptomatic:} \\
\$1,455; P = 0.40 \\
\$960; P = 0.60
\end{array}\]
Fold Back PID and No PID Branches

Symptomatic

PID $360; P = 0.25$

No PID $620; P = 0.37$

(0.63 * 960) + (0.37 * 42) = 620

Path Probabilities

- Determine the probability that each end node will be observed
  - Multiply all of the branch probabilities together
- For each decision branch, sum the product of the probability the end node will be observed times the value of the end node
No Prophylaxis Path Probabilities

\[(0.012096 \times 1455) + (0.018144 \times 630) + (0.01776 \times 42) + (0.952 \times 0) = 29.78\]

Symptomatic

Asymptomatic

PID

No PID

PID

No PID

No Chlamydia

Chlamydia

0.048

0.63

0.37

0.952

(0.012096 \times 1455) + (0.018144 \times 630) + (0.01776 \times 42) + (0.952 \times 0) = 29.78

Point Estimates, Chlamydia Prophylaxis

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Cost</th>
<th>Incr Cost</th>
<th>Eff</th>
<th>Incr Eff</th>
<th>C/E</th>
<th>Incr C/E</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Proph</td>
<td>29.8</td>
<td>0.9698</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proph</td>
<td>41.2</td>
<td>11.4</td>
<td>0.9988</td>
<td>0.0290</td>
<td>0.0290</td>
<td>393</td>
</tr>
</tbody>
</table>

• Is 393 RMB per case of PID averted good value?

Steps in Decision Analysis

1. Imagine the model, and draw the tree
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Sensitivity Analysis

- To conduct sensitivity analysis, replace the numbers in the tree with variables
  - Probabilities
    - \( p_{Chlamyd} \): 0.048
    - \( p_{PID} \): 0.63
    - \( p_{Sympt} \): 0.40
    - \( p_{Protect} \): 0.96
  - Cost
    - \( c_{Chlamyd} \): 42
    - \( c_{Sympt} \): 1455
    - \( c_{Asympt} \): 630
    - \( c_{Azith} \): 40

Adding Variables to Tree

Sensitivity Analysis on Probability, Chlamydia on Cost

Threshold Values:
- Probability, Chlamydia = 0.0
- EV = 41.7 RMB
Sensitivity Analysis on Probability, Chlamydia on Cases of PID

Sensitivity Analysis on Cost, Azithromycin on Cost

Threshold Values:
- Cost, Azithromycin = 28.6 RMB
- EV = 29.8 RMB

Two-Way Sensitivity Analysis on Probability, Chlamydia and Cost, Azithromycin on Cost
Other Issues

- The authors don’t model pre-existing PID along with chlamydia
  - What is the likely impact?
- Prevalence/incidence and the impact on cost-effectiveness as the program continues into the future?

Chen et al.’s Conclusions

- "Programs designed for early identification and treatment of asymptomatic chlamydial infections have the potential to prevent involvement of the upper reproductive tract,..., averting medical costs associated with management of complications and sequelae”
- "To prevent postabortion complications of women in China, we recommend that [women attending a clinic for induced abortion] receive universal prophylactic treatment for C. Trachomatis infection with a single dose of 1 g azithromycin”
- Do you agree? Why / why not?

Advantages of Decision Analysis

- Forces a systematic examination of the problem
- Forces the assignment of explicit values
- Controls complexity and thus avoids processing errors
Disadvantages of Decision Analysis

- Time consuming
- Results difficult to explain
- Methods not well understood or trusted by policy makers

Chen’s Complete Tree for Prophylaxis

How to Use Decision Analysis

- To organize the issues for traditional decision making
- To identify a critical element for intensive study
- To provide information (not answers) for decision making